UAS for Improved Weather Awareness

WINDMAP: Weather Intelligent Navigation Data and Models for Aviation Planning – NASA ULI

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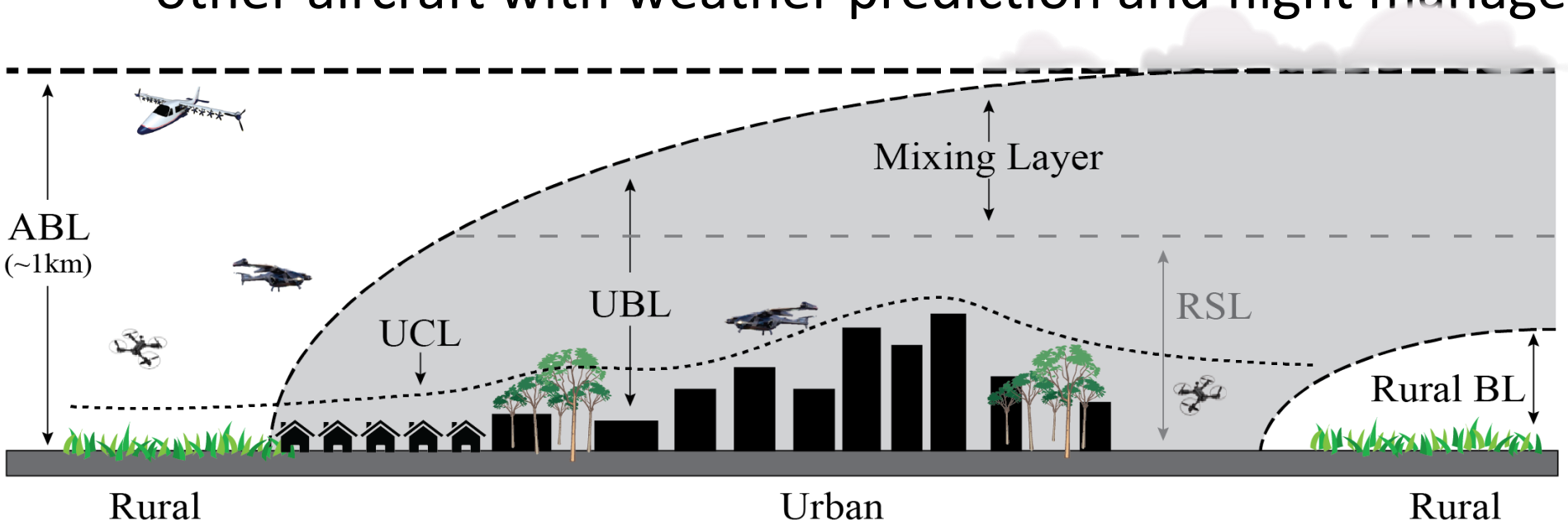
UAS Needs and Benefits

Needs of UAS/UAM for Enhanced Weather Information

UAS Benefits in Providing Weather Observations

Mission: Provide Real-time Weather Awareness for Enhanced UTM Safety Assurance

- Weather creates a variety of barriers to all aircraft operations but in particular drones, which are easily grounded during inclement weather.
- Our goal is to address needs in real-time weather forecasting to improve the safety of low altitude aircraft operations across the AAM space.
- To solve this, we will integrate real-time observations from drones and other aircraft with weather prediction and flight management systems.

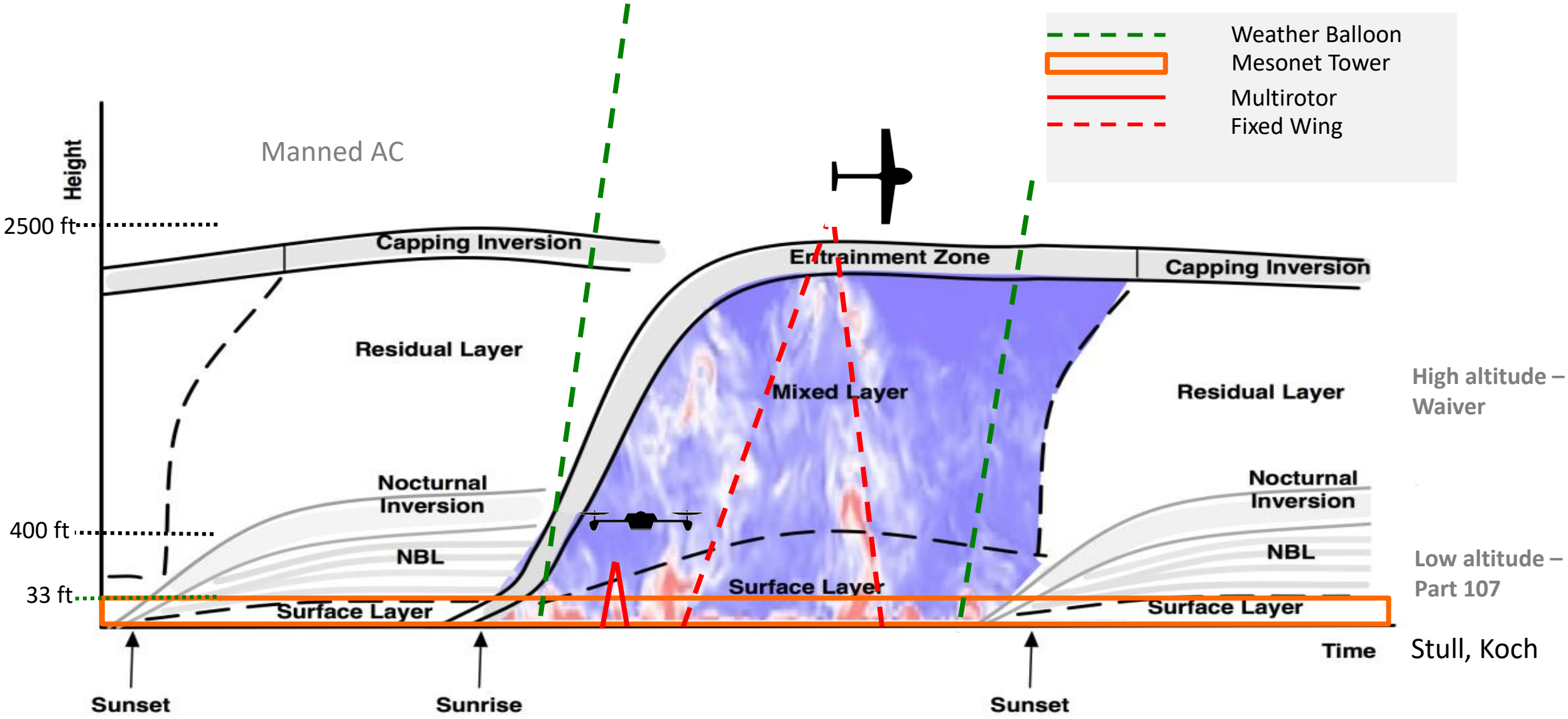


Wind Specific:
Turbulence
Wake Vortices
Shear

Weather Specific:
Fog, Rain
Hail, Icing

Current ABL Sampling Strategies

Comparison of different platform capabilities



In Situ Observations

Novel Autonomous Systems

Existing Capabilities

AMDAR

Radiosonde

Tower

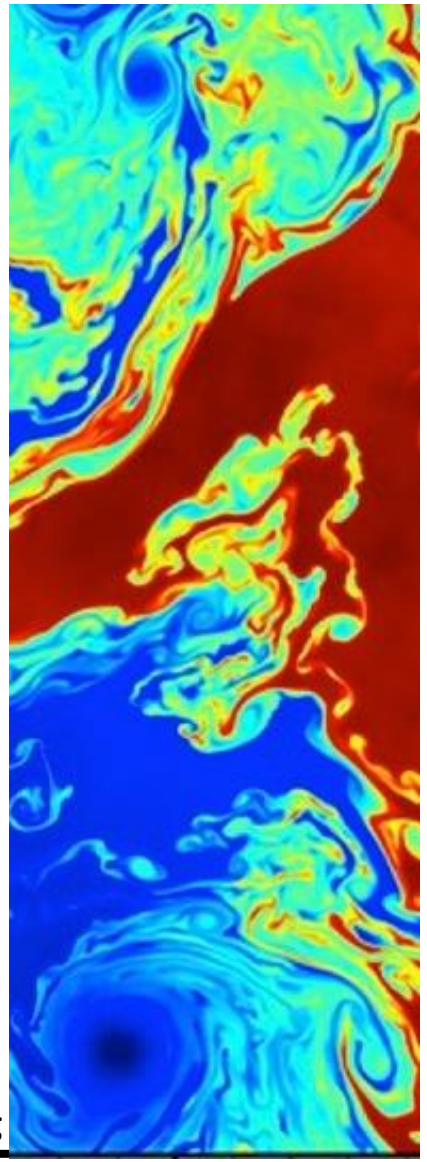
ABL Spatial Resolution Observations

Sparse Sampling

Abundant Sampling

Data Assimilation

Models



UTM Safety Assurance

UAM

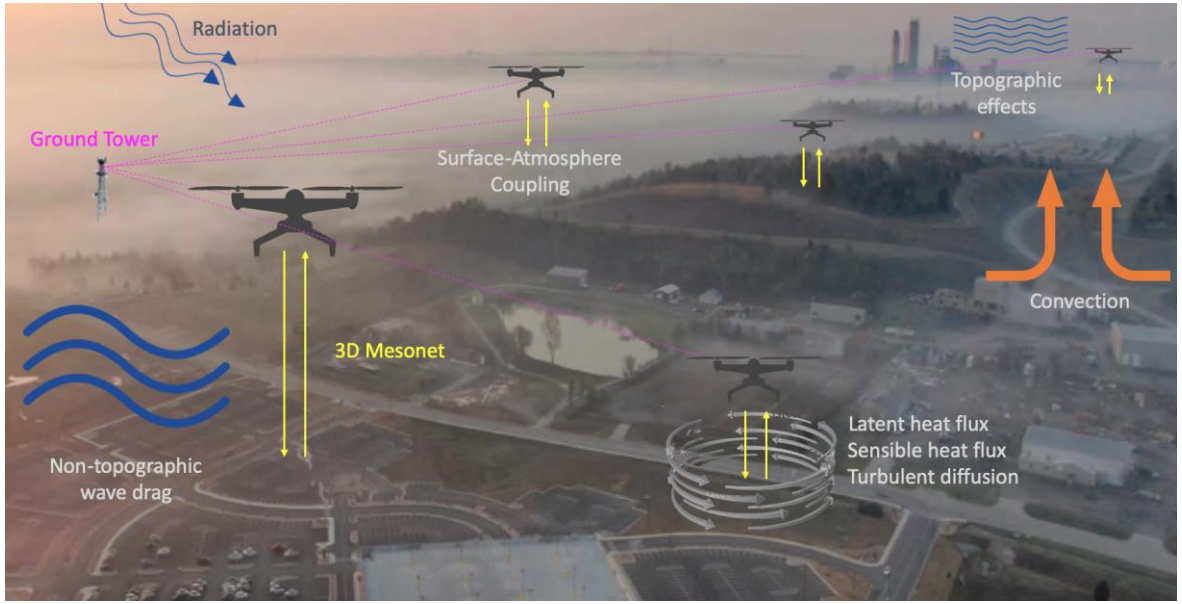
Ops

UAS

ATC

Our Goals

- We will fill the gaps in mesoscale and microscale data and forecasting by
  - Providing Improvements in urban wind modeling and prediction
  - Developing novel in situ observations with UAS for assimilation into forecast models including airport operations
  - Sending real-time reports to pilots of drones and urban air taxis as well as air traffic control (DRONEREPS)



- This will improve the safety and efficiency of the US air transportation system and by working with industry and tribal governments provide unique opportunities for diverse populations.

Technical Challenges and Tasks

TC 1: Autonomous observations

Implementation of autonomous observation systems

- System development
- Validation
- Rural and urban testing

TC 2: Sampling Requirements

Spatial and temporal sampling requirements

- Observation System Simulation Experiments

TC 3: Data Assimilation

Data assimilation

- Optimize DA approaches for real-time implementation into models and reporting system

TC 4: Forecast Reporting

Modeling and reporting

- Automated digital real-time "DRONEREP" capability
- LES simulation for near real-time forecasting

TC 5: UTM

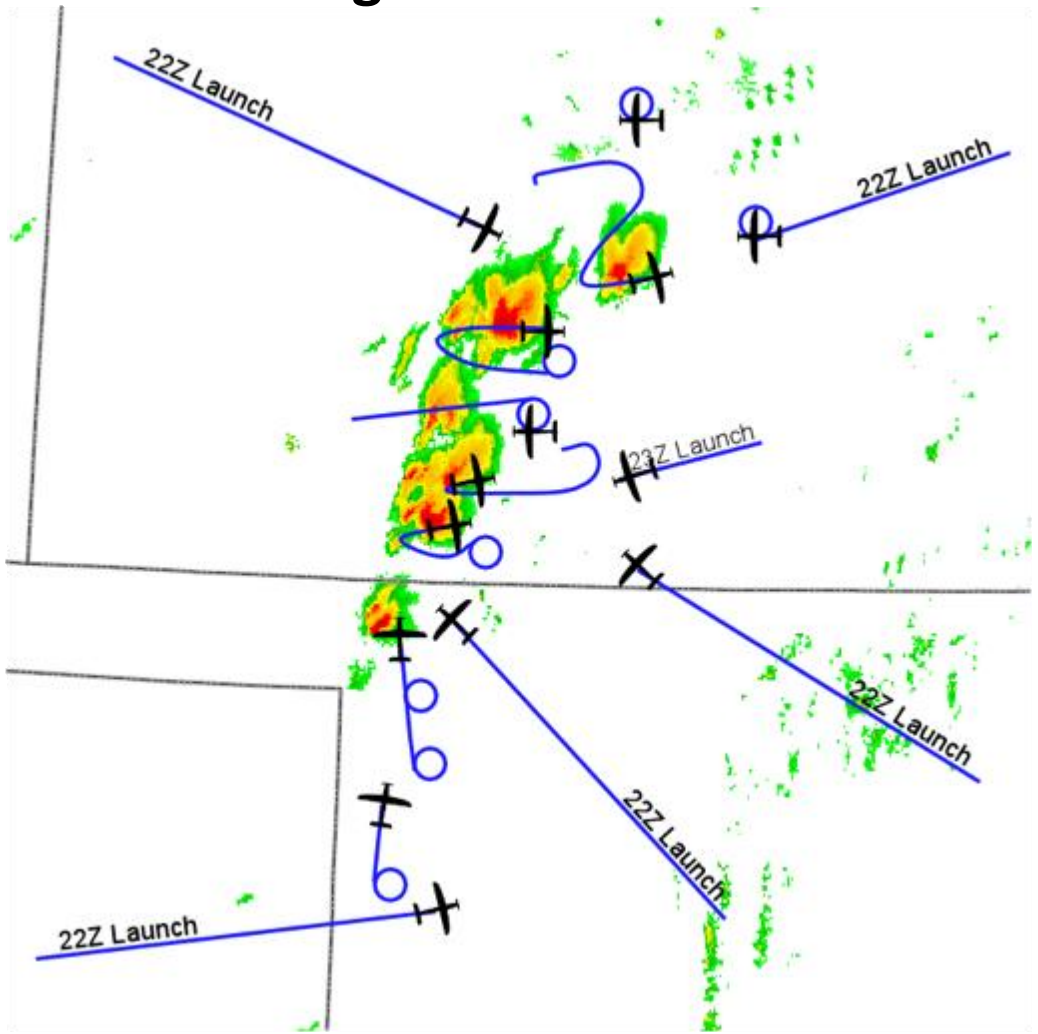
System integration of real-time weather forecasting into UTM & ATMx

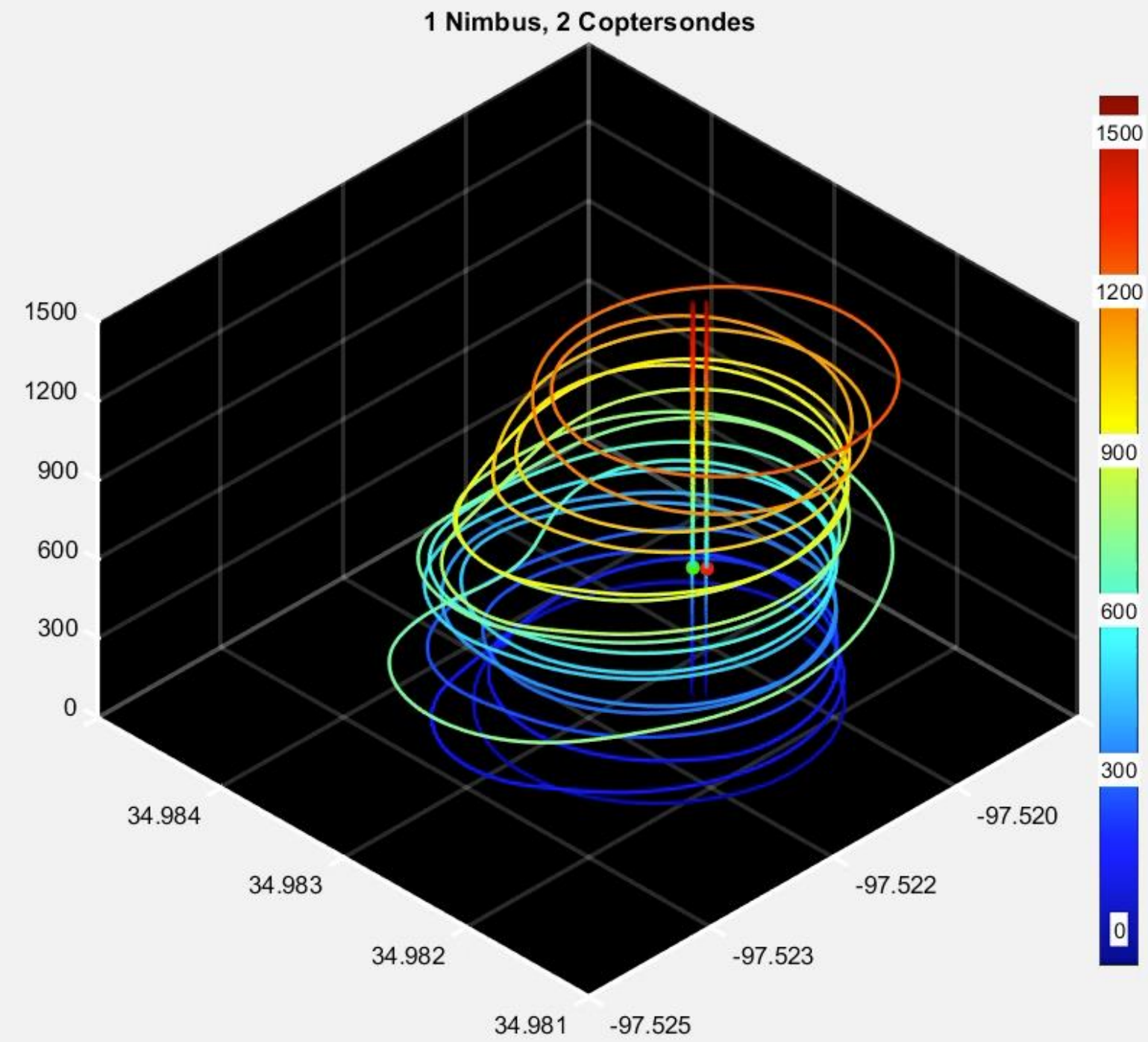
- Integration
- Field trials

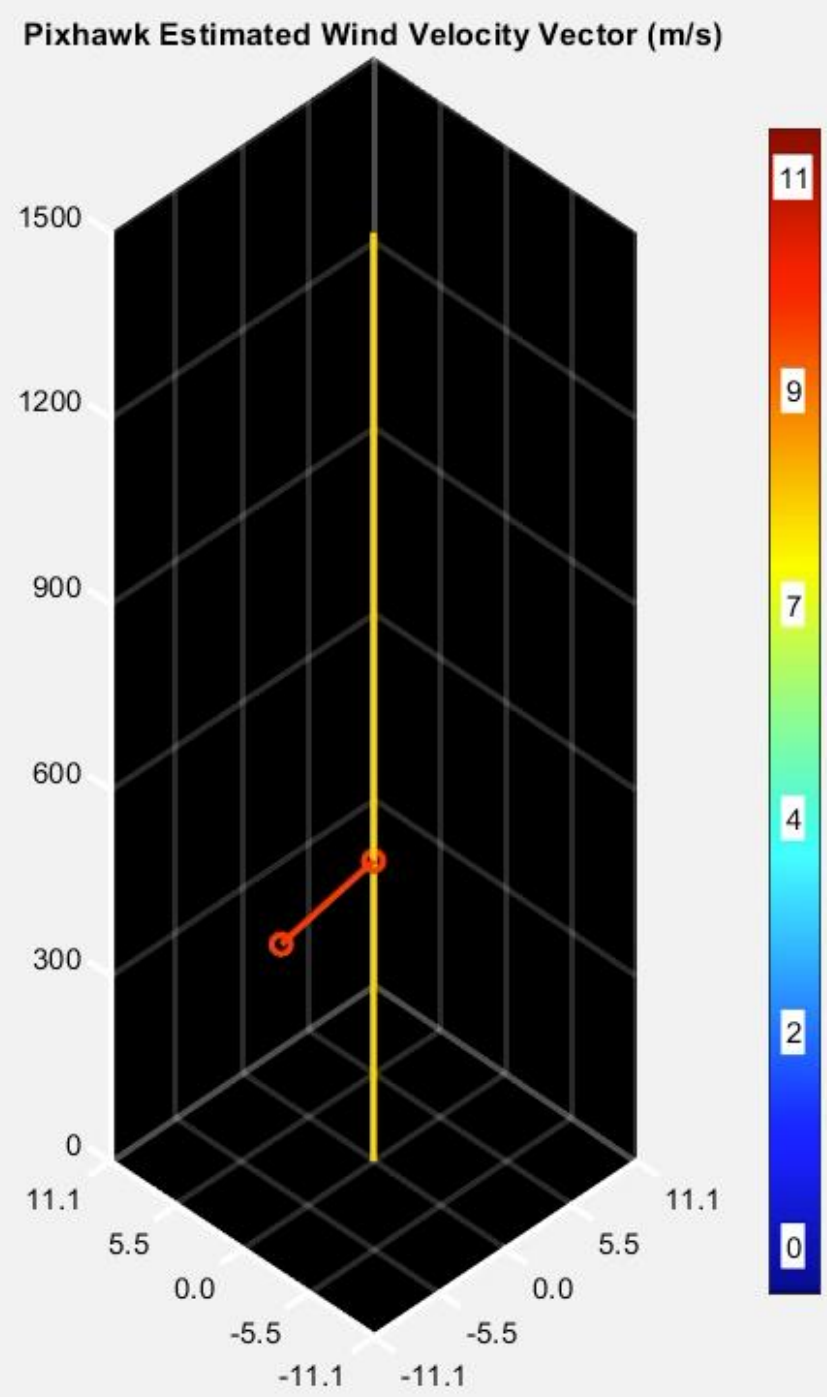
Autonomous Observations

3D Profiling

Targeted Observations




1 Nimbus, 2 Coptersondes
1500
1200
900
600
300
0
34.984
34.983
34.982
34.981
-97.520
-97.522
-97.523
-97.525
1500
1200
900
600
300
0

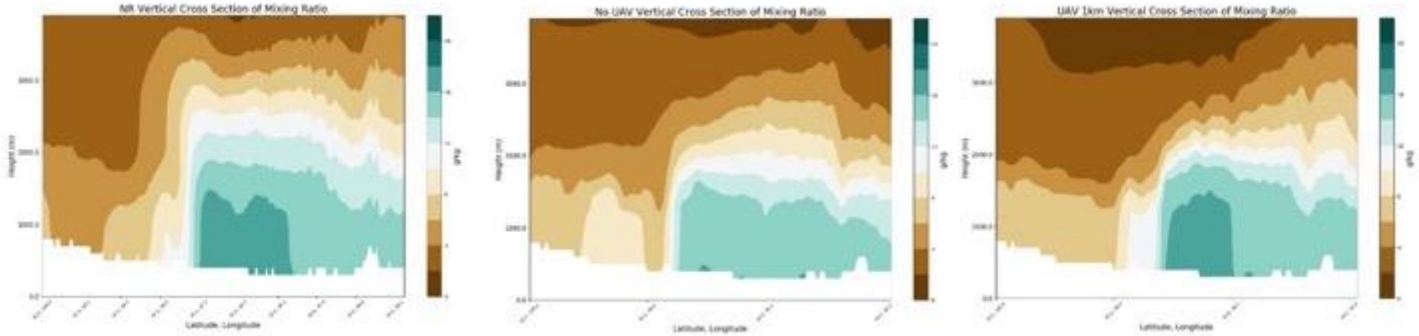

Pixhawk Estimated Wind Velocity Vector (m/s)
1500
1200
900
600
300
0
11.1
5.5
0.0
-5.5
-11.1
11.1
5.5
0.0
-5.5
-11.1
11
9
7
4
2
0

Enhanced Forecasting: Sample Requirements, Data Assimilation & Reporting

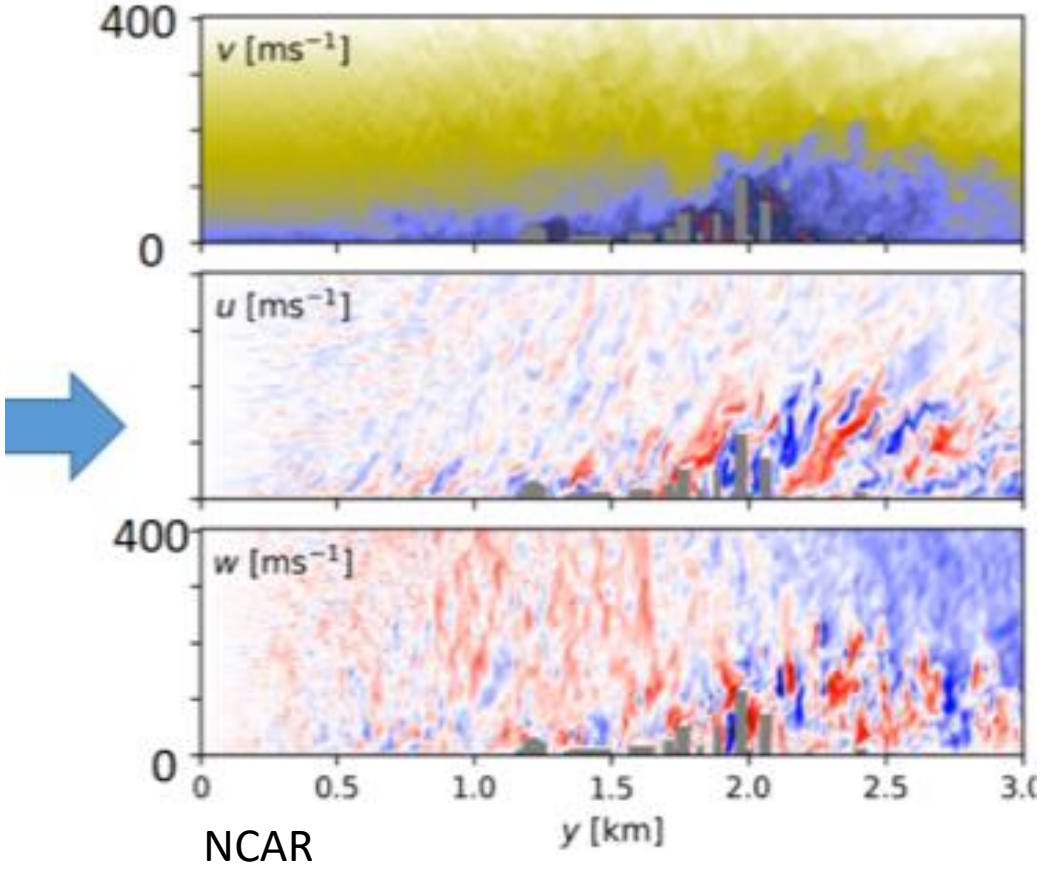
Maximum Flight Altitude (AGL) Experiments

Flight profiles up to 400 ft, 1-km, 2-km, 3-km AGL

Nature | Forecast w/o UAS | Forecast w/ UAS

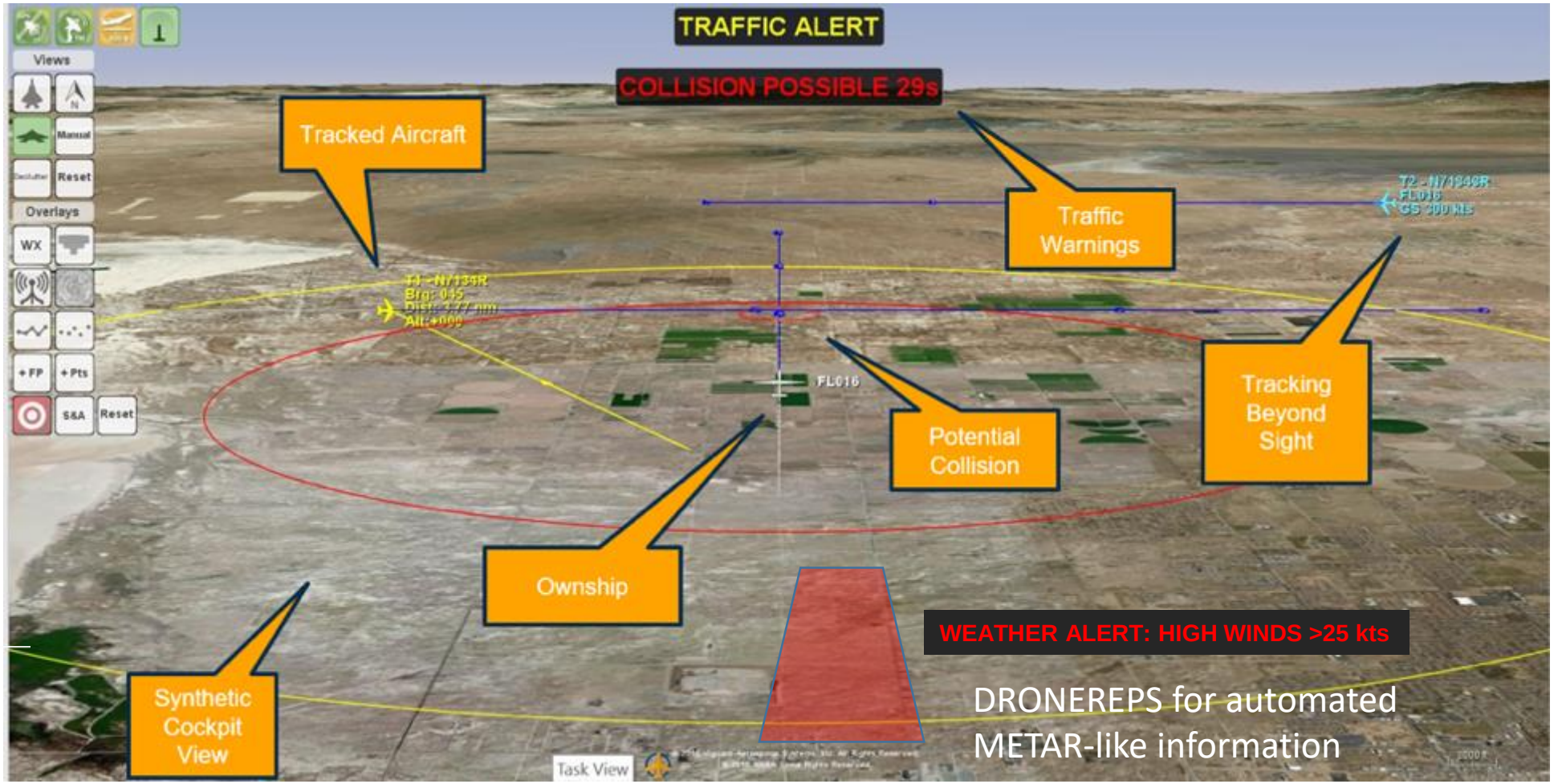


Brewster



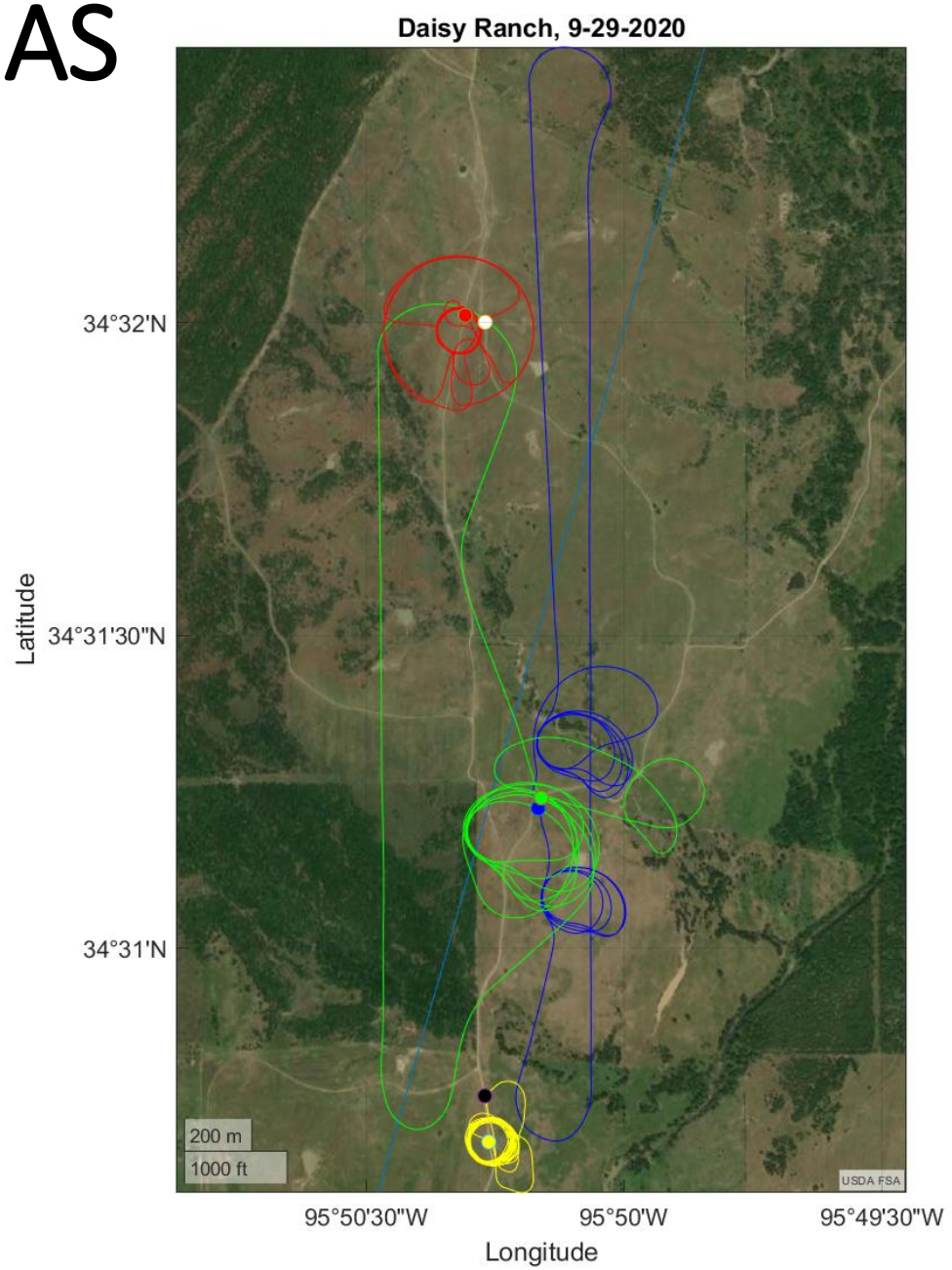
NCAR

Reporting and Weather Aware Planning

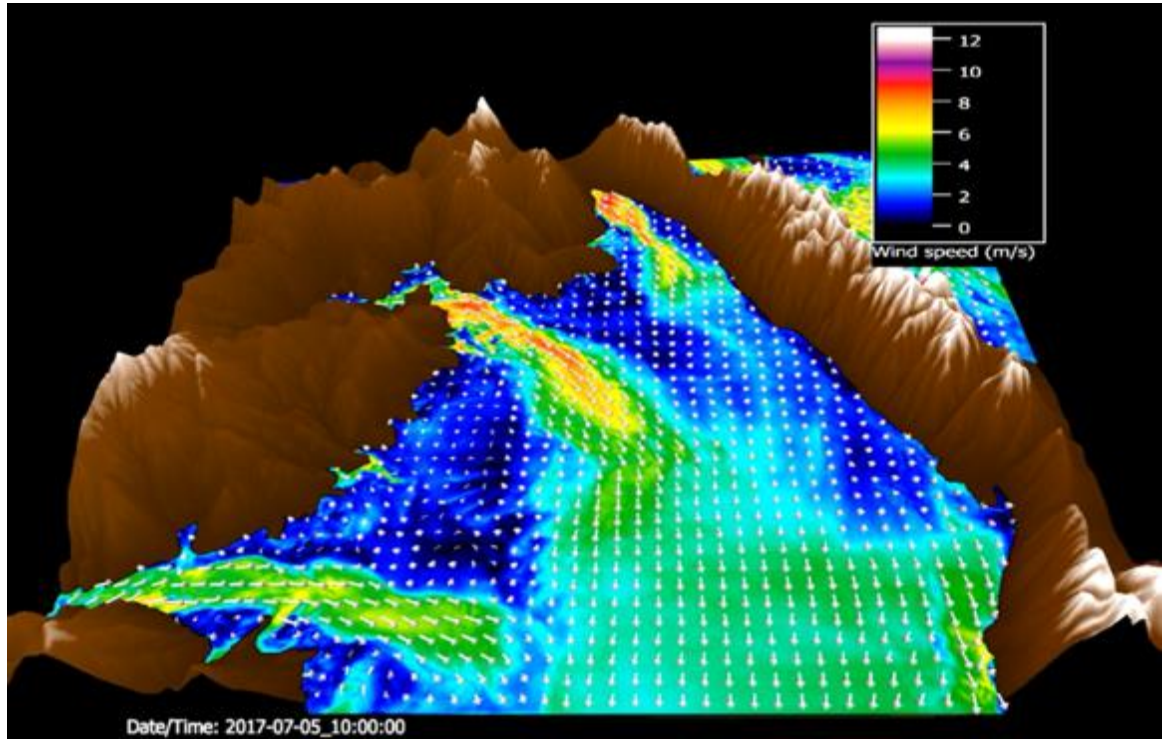


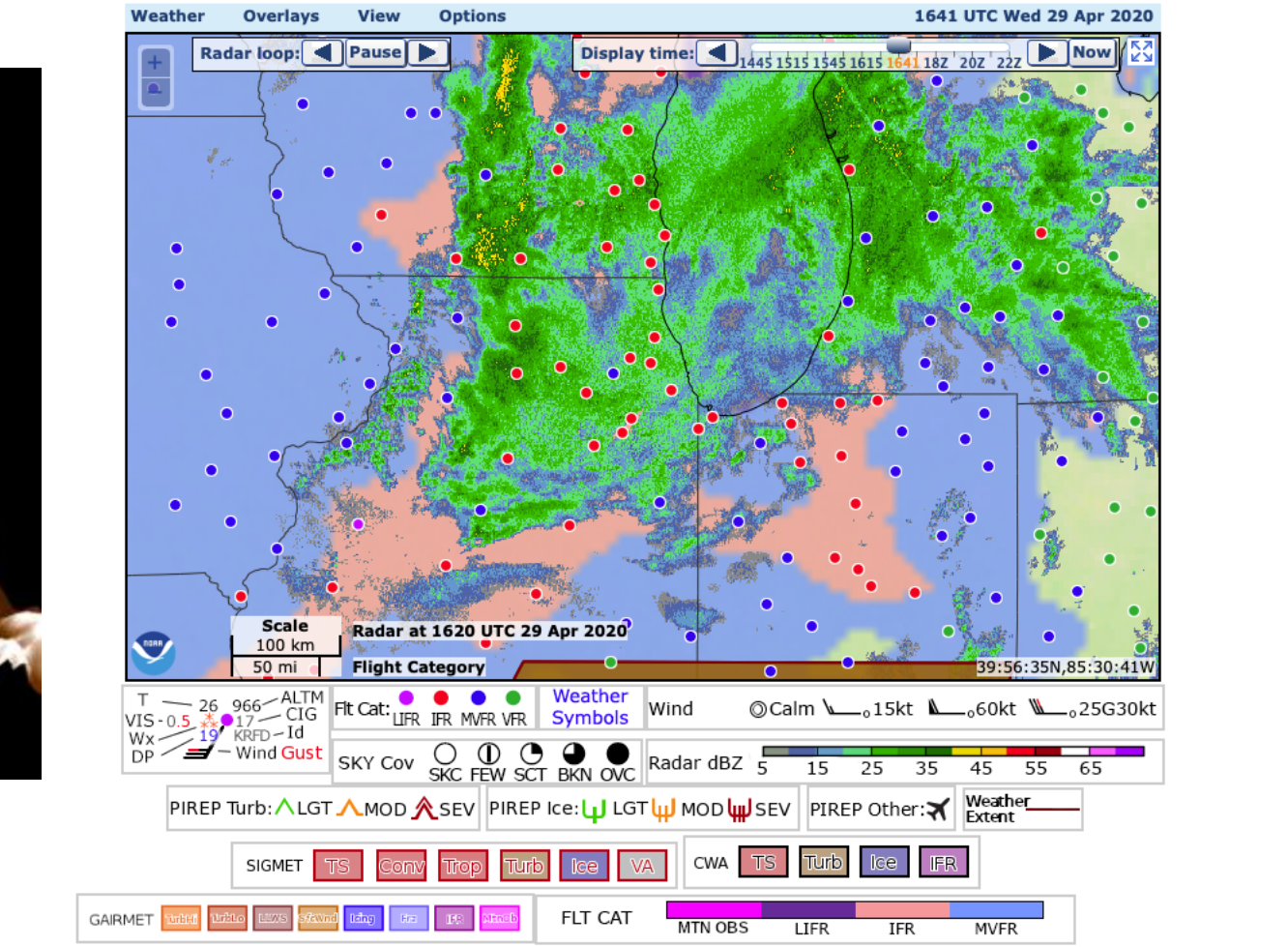
VAS FlightHorizon is already in field testing providing a high TRL foundation for the weather reporting component to build upon. VAS has an exclusive license to NASA algorithms.

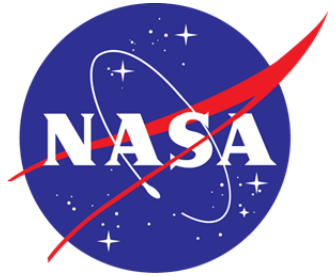
Coordinated Ops in the NAS



Partners


12
10
8
6
4
2
0
Wind speed (m/s)
Date/Time: 2017-07-05_10:00:00


AVIATION WEATHER CENTER
NOAA NATIONAL WEATHER SERVICE
Local Forecast
Go
HOME ADVISORIES FORECASTS OBSERVATIONS TOOLS NEWS SEARCH ABOUT USER
Helicopter Emergency Medical Services Tool
HEMS Tool Info Feedback
April 2020 update information
Weather Overlays View Options
1641 UTC Wed 29 Apr 2020
Radar loop: Pause
Display time: 1445 1515 1545 1615 1641 18Z 20Z 22Z Now
Scale
100 km
50 mi
Radar at 1620 UTC 29 Apr 2020
Flight Category
39:56:35N,85:30:41W
Flt Cat: LIFR IFR MVFR VFR
Weather Symbols
Wind Calm 15kt 60kt 25G30kt
SKY Cov SKC FEW SCT BKN OVC
Radar dBZ 5 15 25 35 45 55 65
PIREP Turb: LGT MOD SEV
PIREP Ice: LGT MOD SEV
PIREP Other:
Weather Extent
SIGMET TS Conv Trop Turb Ice VA
CWA TS Turb Ice IFR
GAIRMET
FLT CAT
MTN OBS LIFR IFR MVFR



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